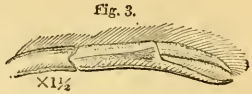
are small and rudimentary; but there is a very large and terminally bilobed lamella, apparently representing the exognath, which extends forward considerably in front of the epistome, where its terminal lobes are somewhat upturned and serve as the lower wall of a tube from the efferent branchial opening. This lamella is continuous posteriorly with the very large epignath, which extends far back into the branchial chamber.

Fig. 3.



Terminal portion of the second pereiopod of the right side.

The fifth, or last, pair of pereiopods are considerably shorter and more slender than the fourth, and subchelate (fig. 4).

The first pleopods have an imperfect articulation about a third of the way from the base to the tip; the basal portion is somewhat triquetral; and the terminal portion expands into a smooth, naked, and thin lanceolate lamella slightly concave posteriorly. The second pleopods are similar to the succeeding pairs, not greatly modified as in *Astacus* and its near allies. The lamellæ are narrow, lanceolate, and nearly equal in size; and the inner lamella bears the two small styliform processes usually characteristic of males among Macrura. The three succeeding pairs of pleopods are similar to those of the second pair; but, as usual, they all want the outer of the two styliform processes on the inner margin of the inner lamellæ.

Fig. 4.

Terminal portion of the fifth pereiopod of the left side.

New Haven, Conn., U. S. A.,
Feb. 11, 1880.

XXVII.—*On the Geological Distribution of the Rhabdophora.* By Charles Lapworth, F.G.S. &c.

Part III. Results.

[Continued from p. 62.]

(A) Geological.—The conclusions which may be drawn from the data now before us, as detailed in the preceding pages, arrange themselves very naturally under two distinct heads. In the first place, we shall consider the various forms of Rhabdophora there enumerated from the geological or stratigraphical point of view, treating of the several groups and individuals as possible indices of the systematic place of their

containing beds. In the second place we shall look upon them from the zoological or palæontological side, noting the geological date of the advent, culmination, and gradual extinction of the known families, genera, and species, and fixing approximately their individual range in Palæozoic time.

Upper Cambrian Rocks.

TABLE II. Showing Range of Upper Cambrian Rhabdophora.

	Malvern Hills.	Shineton Shales.	Alum Shales, Norway.	*Olenus* Skiffar, Westrogothia.	*Dictyonema* Skiffar, Scania.
DICHOGRAPTIDÆ.					
Bryograptus Callavei, *Lapw.*	?	*			
—— Kjerulfi, *Lapw.*	..	..	*		
Clonograptus rigidus, *Hall*	..	?	..	?	?
Dichograptus tenellus, *Linn.*	..	..	..	*	

The oldest Rhabdophora hitherto detected are probably the forms discovered by Mr. Linnarsson in the *Olenus*-beds of Westrogothia, Sweden. These strata are possibly of a somewhat higher antiquity than the Shineton shales of Shropshire, in which Dr. Callaway has discovered corresponding forms.

The only family of Rhabdophora as yet represented in these Upper Cambrian graptolitiferous rocks is that of the Dichograptidæ, to which the vast majority of the forms belong which mark the succeeding Arenig period. Indeed this fragmentary Cambrian graptolitic fauna appears at first sight to be essentially of an Arenig type. One prime distinction, however, can hardly be overlooked. In the Arenig formations the more simple forms, such as *Didymograptus* and *Tetragraptus*, greatly preponderate, the highly complex forms like *Dichograptus* and *Clonograptus* being comparatively rare. In this small Upper Cambrian assemblage, on the other hand, the only forms recognized belong to some of the most highly complex genera known—the British, Norwegian, and Swedish faunas agreeing precisely in this respect.

Ordovician System (*Lower Silurian of Murchison*).

(a) *Arenig Formation.*

†Table III. Showing the Range of the Arenig Rhabdophora.

	Arenig of St. Davids.			Arenig of Shelve.			N. Wales.		Skiddaw Slates.		Norway.	Scania.		N. America.			Australia.
	Lower.	Middle.	Upper.	Lower.	Middle.	Upper.	Tyobry.	Pont Scjont.	Lower.	Upper.		Low. Grapt. Sch.	Mid. Grapt. Sch.	Point Levis.	Riv. St. Anne &c.	Newfoundland.	
Leptograptidæ.																	
Azygograptus Lapworthi, *Nich.*					?				*								
—— cœlebs, *Lapw.*										*							
Dicranograptidæ.																	
Dicellograptus divaricatus, *Hall.*			r.														
Dichograptidæ.																	
Didymograptus affinis, *Nich.*			*			*			*	*		*					
—— arcuatus, *Hall*														*			
—— bifidus, *Hall*			*		*				*	*			*	*			
—— constrictus, *Hall*					*	*						*	*				
—— extensus, *Hall*	*											*		*			
—— extenuatus, *Hall*														*			
—— fasciculatus, *Nich.*										*							
—— gibberulus, *Nich.*									*								
—— indentus, *Hall*			*											*			
—— Murchisoni, *Beck*								*		*							
—— Nicholsoni, *Lapw.*			*			*			*								
—— nitidus, *Hall*									*					*			*
—— patulus, *Hall*		*	*		*	*			*	*		*		*			
—— pennatulus, *Hall*	*													*			
—— similis, *Hall*															*		
—— strictulus, *Linnrs.*												*					
—— sparsus, *Hopk.*	*																
—— Pantonii, *M'Coy*																	*
—— v-fractus, *Salter*									*			*					
Tetragraptus alatus, *Hall*														*			
—— approximatus, *Nich.*														*			
—— Bigsbyi, *Hall*									*					*			
—— bryonoides, *Hall*		*							*			*		*		*	*
—— crucifer, *Hall*									*			*		*			

† These tables include all the forms of Rhabdophora published to this date (Jan. 1880) the geological horizons of which are approximately known. Several species recently described are added to those already enumerated in the preceding portions of this paper. A few are omitted altogether, either because their geological age is uncertain, or because they are of very doubtful specific identification.

TABLE III. (*continued*).

	Arenig of St. Davids.			Arenig of Shelve.			N. Wales.		Skiddaw Slates.			Scania.		N. America.			
	Lower	Middle.	Upper.	Lower.	Middle.	Upper.	Tyobry.	Pont Scionf.	Lower.	Upper.	Norway.	Low. Grapt. Sch.	Mid. Grapt. Sch.	Point Levis.	Riv. St. Anne &c.	Newfoundland.	Australia
Tetragraptus denticulatus, *Hall*														*			
—— fruticosus, *Hall*											*	*			*		*
—— Halli, *Hopk.*		*												*			
—— Hicksi (?), *Hopk.*		*															
—— Headi, *Hall*														*	*	*	
—— quadribrachiatus, *Hall*		*							*			*			*		*
Dichograptus Sedgwicki, *Salt.*									*								
—— octobrachiatus, *Hall*									*					*			*
—— octonarius, *Hall*															*		
Loganograptus Logani, *Hall*									*					*			?
Clonograptus flexilis, *Hall*														*			
—— ramulus, *Hall*														*			
—— Richardsoni, *Hall*														*			
—— rigidus, *Hall*														*			
Clematograptus implicatus, *Hopk.*		*			*												
Trichograptus fragilis, *Nich.*										*							
Temnograptus multiplex, *Nich.*									*			*					
Schizograptus reticulatus, *Nich.*									*								
Goniograptus Thureaui, *M'Coy*																	*
PHYLLOGRAPTIDÆ.																	
Phyllograptus angustifolius, *Hall.*									*		*	*		*		*	*
—— Anna, *Hall*															*		
—— iliciformis, *Hall*														*			
—— stella, *Hopk.*	*																
—— typus, *Hall*									*		*	*		*	*	*	*
DIPLOGRAPTIDÆ.																	
Diplograptus dentatus, *Brongn.*			*		*	*			*	*			?	*	*		*
—— inutilis, *Hall*														*			
Climacograptus confertus, *Lapw.*			*		*		*						*		*		?
—— Scharenbergi, *Lapw.*											*	*	*				
Cryptograptus tricornis, *Carr.*					r.		r.		r.	r.			r.				
——? antennarius, *Hall*									*					*			
——? Hopkinsoni, *Nich.*									*			?	?				
LASIOGRAPTIDÆ.																	
Glossograptus ciliatus, *Emmons*			*				*										
—— armatus, *Nich.*										*							
Retiograptus tentaculatus, *Hall.*														*			*
Hallograptus bimucronatus, *Nich.*							r.										
RETIOLITIDÆ.																	
Trigonograptus ensiformis, *Hall.*	*													*			
—— lanceolatus, *Nich.*									*	*							
—— truncatus, *Lapw.*	*			*													

The grand characteristic of the graptolitic fauna of the Arenig rocks is the extraordinary predominance of those forms of Rhabdophora which compose the family of the Dichograptidæ. In every region where these Arenig strata have been fully investigated they have been found to be locally crowded with the feathery forms of this special group, from the simplest to the most highly complex species. Of the sixty-three forms of Graptolites enumerated in the foregoing Table, forty-five, or nearly three fourths of the entire fauna, belong to this single family; and if we unite with it the dubiously distinct family of the Phyllograptidæ, it will be found to outnumber the representatives of all the remaining families in the proportion of nearly five to one. This marked peculiarity, which gives to our Arenig fauna a special character unique among those of the Lower Palæozoic formations, is not confined to Britain alone, but is fully as characteristic of the Arenig of Scandinavia, and of North America, as well as of the antipodal regions of Australia.

Within the generally accepted provisional limits of the Arenig formation there is some evidence of a progressive change in the relative preponderance of the various genera of the Dichograptidæ in proportion as we ascend in the vertical series. As we have already pointed out, the more complex genera seem to have been the first to appear; and in the lowest Arenig beds they are still abundant, but they are intermixed with simple forms. In the Middle Arenig strata the highly complex and beautifully regular genera like *Clonograptus* and *Dichograptus* appear to have died out, and the prevalent complex genus in these beds is the four-armed *Tetragraptus*. In the true Upper Arenig the bifid genus *Didymograptus* is supreme. The monotonous character of the fauna of these higher beds, due to the presence of multitudes of examples of this single genus, is but slightly affected by the presence of scattered examples of irregularly compound genera, very different in their structural features from the regularly dichotomizing forms of the earlier beds.

All the regularly dividing forms of Dichograptidæ with more than four branches appear to have vanished before the close of the so-called Middle Arenig. There the four-armed *Tetragraptus* is most characteristic. The bifid genus *Didymograptus* is rare in the lowest beds; but its individuals increase rapidly in numbers as we ascend the succession, filling the places left vacant by the disappearing complex genera, till finally in the Upper Arenig it becomes the most prevalent and characteristic form. The rarer and irregularly branching complex genera which there accompany it seem to point to-

wards *Cœnograptus*, one of the most striking forms of the distinct family of the Leptograptidæ.

From the base to the summit of the Arenig formation the Dichograptidæ are accompanied by the rarer forms of the most intimately allied family of the Phyllograptidæ. The single genus of which this family is at present composed has not hitherto been met with in true Cambrian rocks, and is unknown above the lower limit of the Llandeilo formation. Like the Dichograptidæ, its species are typical of the Arenig rocks from Scandinavia to the Antipodes. We know too little of the beautiful forms of this family to note any general change in their superficial features during this extended period. As yet, indeed, we have not collected sufficient material for the complete study of a single British species.

As a general rule, species belonging to the remaining families of the Diprionida are, in the Arenig, the rarest of fossils. Locally, however, an occasional stratum is met with in which they are tolerably abundant. Three distinct families, however, are already recognizable, all making their first known appearance almost simultaneously near the boundary line between the Lower and Middle Arenig rocks. The Diplograptidæ are represented by the whole of the three component genera; but the species are all somewhat generalized in character, and the most generalized genus, *Cryptograptus*, claims, as might have been expected, the majority of the known forms. The intermediary and provisional family of the Lasiograptidæ is represented by the bizarre genera *Glossograptus* and *Retiograptus* of Hall. The latter, which is as yet confined to the Lower Arenig of Canada and Australia, is also the most generalized genus of its family, combining structural features subsequently found separate in *Glossograptus* and *Lasiograptus*. The Retiolitidæ are represented by a single genus only, *Tetragraptus* of Nicholson, which seems likewise of a transitional character, leading through the later genus *Gymnograptus* of Tullberg into the family of the Lasiograptidæ.

Of the Monoprionida outside the dominant family of the Dichograptidæ few forms are known, a single British example of the Dicranograptidæ from the Upper Arenig of Abereiddy Bay and two species of the family of the Leptograptidæ from the corresponding strata of the Upper Skiddaw group are all that have hitherto been published from these Arenig rocks.

Lower Arenig (of Hicks).—The only locality where graptolitiferous strata near the base of the Arenig formation have been carefully examined in Britain is at Whitesand

Bay, near St. Davids, where the few forms that have hitherto been collected are chiefly *Diplograpti* and *Cladophora*. I suspect, however, that the oldest strata of Point Levis, with highly complex Dichograptidæ, will be found to be on or near this horizon, as well as some of the lowest Skiddaw beds. They may eventually have to be placed at the summit of the Cambrian.

Middle Arenig.—To this provisional horizon the more typical Arenig beds of Skiddaw and the Lower Graptolite schists of Sweden undoubtedly belong. They appear to be marked generally by the prevalence of the genera *Tetragraptus* and *Didymograptus*, in combination with an admixture of regular and irregular complex genera of Dichograptidæ. The limits of this subformation are as yet undefined either above or below; but if we regard the Skiddaw and Scanian beds as provisionally typical, we find in this division few Diprionida, and those which are present rise upwards into the succeeding subformation.

Upper Arenig.—Everywhere in Britain these beds are composed of shaly strata varying in tint from light green to black. The Upper Skiddaw of the Lake District possibly includes some horizons not embraced in the more typical and Upper Arenig beds of South Wales, or in the corresponding Scanian strata that overlie the Swedish *Orthoceras*-Limestone; but in all these beds the salient character of the Graptolite fauna is the predominance of individuals of *Didymograptus*, among which the "geminiform" species *D. bifidus*, Hall, is especially common. No regularly compound genera of the Dichograptidæ have as yet been procured from this horizon; but the irregularly branched forms of the type of *Trichograptus fragilis*, Nich., are occasionally met with. Diprionida of the families noted above are present, and apparently in greater numbers than in the underlying zone. Phyllograptidæ are locally abundant, appearing on this horizon for the last time.

Our knowledge of the range of the Graptolites within the Arenig formation is as yet too defective to allow us to fix even the approximate range of the species of Dichograptidæ. Of the less-understood forms of Diprionida we know hardly any thing with certainty; and the few recognized zoological facts are deprived of the geological value they would otherwise possess in our catalogue by the undoubted intermixture of species derived from several distinct stratigraphical zones.

(b) *Llandeilo Formation.*

TABLE IV. Showing Range of Llandeilo Rhabdophora.

	Abereiddy Bay.		Whitland.	Pwllacca.	Builth.			Meadowtown.			Tiddyn Diewm.	Bellewston (Meath).	Sweden.			Trenton Limestone.
	Lower.	Middle.			Lower.	Middle.	Upper.	Lower.	Middle.	Upper.			*Didy. geminus.*	*Glossograpt.* Zone.	*Gymnograpt.* Zone.	
LEPTOGRAPTIDÆ.																
Leptograptus flaccidus, *Hall*	..	?														
Cœnograptus gracilis, *Hall*	..	..	..	..	..	?	..	..	..	..	?					
DICRANOGRAPTIDÆ.																
Dicellograptus divaricatus, *Hall*	?	?														
—— intortus, *Lapw.*	..	..	..	..	..	*										
—— patulosus, *Lapw.*	..	..	..	..	..	*										
—— sextans, *Hall*	..	..	..	..	..	*	..	..	..	..	*					
Dicranograptus ramosus, *Hall*	..	..	..	..	..	..	..	..	..	..	*					
—— formosus, *Hopk.*	..	..	..	..	..	*										
DICHOGRAPTIDÆ.																
Didymograptus euodus, *Lapw.*	*															
—— Murchisoni, *Beck*	*	..	*	*	*	*	..	*	..	..	..	*	*			
—— Nicholsoni, *Lapw.*	..	..	*	*												
Goniograptus ?, sp.	..	..	*													
DIPLOGRAPTIDÆ.																
Diplograptus amplexicaulis, *Hall*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	*
—— angustifolius, *Hall*	..	..	..	..	..	..	..	..	..	..	*					
—— dentatus, *Brongn.*	..	..	*	*	..	..	..	..	..	..	*					
—— rugosus, *Emmons*	..	..	..	..	..	*	..	..	..	..	..	..	..	..	*	
—— perexcavatus, *Lapw.*	..	..	..	..	..	..	*									
—— Whitfieldii, *Hall*	..	..	..	..	..	..	..	..	..	..	*					
Climacograptus cælatus, *Lapw.*	*	..	..	*	..	*										
—— bicornis, *Hall*	..	..	..	..	..	..	..	..	..	..	*					
—— confertus, *Lapw.*	..	..	*	*	..	*	*	..	..	..	..	..	*	*		
—— Scharenbergi, *Lapw.*	..	..	..	..	..	..	*	..	..	*	*	..	*	*	*	
Cryptograptus Schæferi, *Lapw.*	..	..	..	..	..	..	*									
—— tricornis, *Carr.*	r.	..	..	r.	..	..	..	..	..	..	..	..	r.	r.	r.	
LASIOGRAPTIDÆ.																
Lasiograptus retusus, *Lapw.*	..	..	..	..	..	..	..	..	..	*						
Glossograptus Hincksi, *Hopk.*	..	..	..	*	..	..	..	..	..	..	*					
RETIOLITIDÆ.																
Gymnograptus Linnarssoni, *Tullb. MS.*	..	..	..	..	..	..	..	..	..	..	..	..	..	*		

The collective Graptolite fauna of the typical Llandeilo beds is essentially of a transitional character. In the true Arenig strata, as we have already shown, the feathery Dichograptidæ and Phyllograptidæ preponderate to such an extent that the species of the few additional families represented occur only as sparsely scattered specimens among the hosts of individuals of *Didymograptus* and its allies. In the typical Bala or Caradoc formation, as will be shown in the sequel, these old Arenig families have utterly vanished, and the faces of the graptolitiferous laminæ are now crowded with multitudes of Dicranograptidæ and Diplograptidæ. The Llandeilo formation, as geologists provisionally define it at present, combines in its collective fauna both the Arenig and Bala types, and shows the gradual passage of the one into the other. *Phyllograptus* is absent throughout; but in the Lower Llandeilo *Didymograptus* is as densely abundant as in the Upper Arenig; while Diplograptidæ and Dicranograptidæ are very rare or only locally prolific. In the Upper-Llandeilo and the transitional Llandeilo-Bala or Glenkiln strata, on the other hand, a Dichograptid is the rarest of fossils, while the Dicranograptidæ and Diplograptidæ occur in countless multitudes.

Lower Llandeilo.—An occasional example of an irregularly compound genus of the Dichograptidæ has been met with in the lowest zone of the Llandeilo, as near Llan Mill &c., where I detected forms allied to *Tetragraptus* and *Goniograptus*, M'Coy; but, as in the immediately underlying beds of the Upper Arenig, the most prolific genus in the Lower Llandeilo is emphatically *Didymograptus*, M'Coy. Species with parallel and with widely divergent arms are present; but both in Britain and Scandinavia the "geminiform" species of the type of *Didymograptus Murchisoni*, Beck, occur in abundance everywhere, while the "patuliform" species of the type of *D. patulus*, Hall, are only locally present.

The black-shale beds composing the so-called Lower Llandeilo of Hicks may almost be denominated the "*Zone of Didymograptus Murchisoni*, Beck." This beautiful fossil abounds in the dark schists of the Lowest Division of the Llandeilo of Abereiddy Bay, near Whitland and Llan Mill, at Llandeilo, at Builth, and in the mining area of Shelve. It reappears in like abundance in the "*Didymograptus geminus* beds" of Scania, in Southern Sweden. In all these localities it is accompanied by many of the Upper Arenig species enumerated in the previous section, or by very closely allied forms, including representatives of *Diplograptus dentatus*?, Brongn., *Climacograptus cœlatus*, Lapw., and *C. confertus*, Lapw.,

together with new and very remarkable forms of *Cryptograptus* and *Glossograptus*. In many respects this black-shale zone is most naturally regarded as the upward extension of the deep-water sediments of the Upper Arenig; and we may eventually be forced to unite it more closely with that subformation in our improved schemes of geological classification.

Middle Llandeilo.—In the coarse grits, sandstones, and felspathic ashes that together make up the greater part of the succeeding Middle Llandeilo subformation, *Didymograptus Murchisoni* and some of its varieties are still present, but are excessively rare. Of other forms few are known; *Diplograptus foliaceus*, Murch., and *Climacograptus Scharenbergi*, Lapw., are all that have been actually recognized in Britain; but if the *Glossograptus* zone of the Scanian Middle Graptolite schists admits of approximate parallelism with this subformation, there fall to be added many additional species, of which the commonest Swedish forms are allies of the prolific *Glossograptus Hincksi*, Hopk., and *Diplograptus rugosus* of the later Scottish Glenkiln formation.

Upper Llandeilo.—The strata that lie between the typical Llandeilo Limestone of South Wales and the Bala Limestone of the North are not yet sufficiently studied to allow us to fix the line of demarcation between the two formations to which these calcareous zones give their titles. As we have already pointed out, the lower strata are undoubtedly of Llandeilo age; but the larger mass of the beds lies well within the limits of Sedgwick's Bala formation. Before we reach the limestones and calcareous shales with *Ogygia Buchi* that lead up into the Upper Llandeilo formation, all the geminiform *Didymograpti* so characteristic of the underlying beds have totally disappeared; and I know as yet of no forms of *Didymograptus* that have hitherto been collected in the Upper Llandeilo of Wales. They must, however, be locally present; for patuliform species occur in the higher Glenkiln shales. *Diplograpti*, however, are abundant, especially forms of the type of *Cryptograptus tricornis*, Carr., and *Climacograptus Scharenbergi*, Lapw. Here also we meet for the first time with the elegantly symmetrical genus *Cœnograptus* of Hall, so characteristic of the Glenkiln shales, and its constant and highly prolific though somewhat diminutive associate the species *Dicellograptus sextans* of Hall, which in the Glenkiln period is as numerically abundant as *Didymograptus Murchisoni* in the Upper Arenig.

TABLE V. Showing Range of Glenkiln or Llandeilo-Bala Rhabdophora.

		Scotland.		Ireland.				Sweden.	N. America.				
	Llanfaelrhys.	Glenkiln Shales.	Stinchar Valley.	Ballygrot.	Tramore Bridge.	Balleymoney.	Six-Mile Bridge.	*Scharenbergi* Zone.	Norman's Kiln.	Tacomic Shales.	Utica Slate.	St. Lawrence.	Nevada.
LEPTOGRAPTIDÆ.													
Leptograptus flaccidus, *Hall*	..	*	*	*	*	?	*	..	?				
Amphigraptus radiatus, *Lapw.*	..	*	..	*									
Cœnograptus gracilis, *Hall*	..	*	..	*	*	..	..	..	*	*	..	*	
—— surcularis, *Hall*	..	*	..	*	..	..	..	..	*				
—— pertenuis, *Lapw.*	..	*	..	*									
—— explanatus, *Lapw.*	..	*											
DICELLOGRAPTIDÆ.													
Dicellograptus divaricatus, *Hall*	..	*	?	*									
—— intortus, *Lapw.*	..	*	..	*									
—— patulosus, *Lapw.*	..	*	..	..	..	..	..	..	*	..	..	*	
—— sextans, *Hall*	*	*	..	*	*	*	*	..	*	..	..	*	
Dicranograptus formosus, *Hopk.*	*	*	*	*									
—— furcatus, *Hall*	..	..	..	..	..	..	..	..	*				
—— Nicholsoni, *Hopk.*	..	*	..	*									
—— ramosus, *Hall*	..	*	*	*	*	*	..	..	*	..	*	*	*
—— ziczac, *Lapw.*	..	*	..	*									
DICHOGRAPTIDÆ.													
Didymograptus serratulus, *Hall*	?	?	..	..	..	..	..	..	*	*	*		
—— superstes, *Lapw.*	..	*	..	*	?	?	?	..	?				
Clematograptus multifasciatus, *Hall*	..	..	..	..	..	..	..	..	*				
DIPLOGRAPTIDÆ.													
Diplograptus angustifolius, *Hall*	..	..	..	..	..	..	..	..	*				
—— euglyphus, *Lapw.*	..	*	*	*	..	..	..	*					
—— foliaceus, *Murch*	..	*	*	*	*	..	*	..	*	..	*	*	*
—— ? mucronatus, *Hall*	..	..	..	..	..	?	..	..	*				
—— perexcavatus, *Lapw.*	..	*	*	*									
—— rugosus, *Emmons*	..	*	*	..	..	..	..	*	*	*	*	..	*
—— Whitfieldii, *Hall*	..	*	..	*	..	..	..	..	*				
Cryptograptus tricornis, *Carr.*	..	*	*	*	..	..	..	..	*				
Climacograptus bicornis, *Hall*	..	*	*	*	*	?	*	..	*	..	*	*	
—— cælatus, *Lapw.*	..	*	*	*									
—— Scharenbergi, *Lapw.*	..	*	*	*	..	..	..	*					
LASIOGRAPTIDÆ.													
Glossograptus ciliatus, *Emmons*	..	..	..	..	..	..	..	..	..	*			
—— fimbriatus, *Hopk.*	..	*											
—— Hincksi, *Hopk.*	..	*	*	*	..	..	..	?					
—— spinulosus, *Hall*	..	..	..	..	..	..	..	..	*				
Lasiograptus Harknessi, *Nich.*	..	*	*	*									
Hallograptus bimucronatus, *Nich.*	..	*	..	..	..	..	*	..	?				
RETIOLITIDÆ.													
Clathrograptus cuneiformis, *Lapw.*	..	*	..	*									
—— Geinitzianus, *Hall*	..	..	..	..	..	..	..	..	*				

Llandeilo-Bala or Glenkiln Shales.—In these unplaced beds, which possibly include parts of the higher Llandeilo and Lower Bala, as these formations are defined at present, the collective fauna is essentially of the Bala type. A single patuliform species of *Didymograptus* (perhaps two) is all that remains to represent the hosts of Dichograptidæ of the Arenig age; and this becomes extinct before we reach the highest beds of the subformation. The characteristic fossil of the Glenkiln shales is *Cœnograptus gracilis*, Hall, of which it may be regarded as the special zone. This well-marked fossil occurs upon the Glenkiln horizon in Britain, Scandinavia, America, and Australia; it is accompanied by some few allied species of the same genus, and more markedly by crowds of Dicranograptidæ. *Dicranograptus ramosus*, a fossil of the overlying Bala, accompanies *Cœnograptus* in its range from Britain to the Antipodes, with some closely allied transitional forms of the type of *Dicranograptus formosus*, Hopk. One of the most conspicuous fossils of the zone is *Dicellograptus sextans*, which occurs in extraordinary abundance in the lower beds, and probably equals *Cœnograptus* in its extended geographical range. In Scotland and Wales, and in the Norman's-Kiln beds of North-east America, it is also associated with some closely allied forms, representative of *Dicellograptus divaricatus*, Hall.

Diplograptidæ are everywhere abundant. *Diplograptus rugosus*, Emm., is one of the commonest species; and the beautiful form *D. euglyphus* (? *D. putillus*, Hall) is locally prolific. *D. foliaceus*, Murch., is always present, but is less abundant than in the succeeding Bala-Caradoc beds. *Cryptograptus tricornis*, Carr., is frequently seen in several varieties, and the peculiar form *D. perexcavatus*, Lapw. But the species most commonly met with are undoubtedly those of the genus *Climacograptus*. *C. cœlatus*, Lapw., *C. Scharenbergi*, Lapw., and *C. bicornis*, Hall, are all present, the latter in many peculiar subspecific forms.

Of the Lasiograptidæ there are several species; and the members of this family are more abundant in this zone than upon any other horizon hitherto detected in Britain. *Lasiograptus costatus*, Lapw., a possible variety of *L. Harknessi*, Nich., is abundant in the south of Scotland and in the north of Ireland. The provisional genus *Hallograptus* of Carruthers, with its scopulate reproductive appendages, is as yet wholly confined to this zone, where it has been met with in Scotland, Ireland, and North America. *Glossograptus*, Emm., here presents us with some of its latest species; their highly

spinose polyparies are not uncommon even in the highest Glenkiln.

The Retiolitidæ are among the rarest of the Glenkiln fossils in Britain and America, where the lattice-like genus *Clathrograptus*, Lapw., is all that represents the family upon this horizon. In Sweden, however, the extraordinary genus *Gymnograptus* of Tullberg, which points in the direction of the ancient *Trigonograptus*, Nich., is so abundant in strata hardly, if at all, inferior to the lowest Glenkin beds as to give its name to the containing zone.

The zoological features of this British Glenkiln zone and its Irish and American representatives are so unique, and at the same time are so invariable throughout its extraordinary range, that the Australian strata with *Cœnograptus gracilis*, Hall, &c., may be assigned with tolerable certainty to this zone, which, like the older Arenig and Lower Llandeilo zones, will probably be proved to have had a geographical extension that was worldwide.

[To be continued.]

XXVIII.—*New South-American Coleoptera, chiefly from Ecuador.* By Charles O. Waterhouse.

The species described in this paper were, with a few exceptions, collected by Mr. Buckley in Ecuador, chiefly in the neighbourhood of Chiguinda and Sarayacu. The specimens are all in the British-Museum collection.

Cicindelidæ.

Oxychila glabra, n. sp.

Nigra, nitidissima, palpis antennisque testaceis, his basi nigris, singulis elytris V flavo notatis, femoribus rufis apice nigris, tibiis tarsisque testaceis.

♂. Long. 9 lin.

A glabrous species resembling *O. nigro-œnea*, Bates, but with shorter elytra and narrow labrum. Head lightly transversely impressed behind the eyes, with numerous, short, longitudinal wrinkles forming a band between the eyes. Labrum narrowed and acuminate anteriorly, with no distinct denticulations laterally. Palpi pale testaceous. Thorax rather shorter than in *O. nigro-œnea*, rather more constricted in